

SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT
NPDES PERMIT RENEWAL

TESTIMONY/COMMENTS OF MICHAEL D. BRYAN, Ph.D.
ROBERTSON-BRYAN, INC.

On

THE JUSTIFICATION FOR REQUESTED THERMAL PLAN EXCEPTIONS AND
PROPOSED ALTERNATIVE TEMPERATURE LIMITATIONS, AND THE NEED FOR AND
UTILITY OF FISH BEHAVIOR STUDIES REQUESTED BY USFWS TO JUSTIFY THE
REQUESTED EXCEPTIONS

On behalf of the

SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT

I am Dr. Michael D. Bryan. I have a Ph.D. in Fisheries Biology and Aquatic Toxicology. I have 23 years of combined research and consulting experience addressing how physical, chemical, and biological characteristics of aquatic habitats affect fish and other aquatic life. I am a partner and principal scientist at Robertson-Bryan, Inc. (RBI), an engineering and environmental consulting firm located in Elk Grove, California. A copy of my resume, which accurately describes my education, training, and experience in fisheries and water quality, is attached.

BACKGROUND

In July 2010, RBI issued a report to the Regional Water Quality Control Board, Central Valley Region (Regional Water Board), on behalf of the Sacramento Regional County Sanitation District (SRCSD) titled: *Thermal Plan Exception Justification for the Sacramento Regional Wastewater Treatment Plant* (hereafter referred to as the Thermal Plan Exception Report). The Thermal Plan Exception Report had been preceded by a similar report originally filed with the Report of Waste Discharge. The Thermal Plan Exception Report (prepared in collaboration with Flow Science, Inc.) was submitted to the Regional Water Board in support of the Regional Water Board's NPDES permit renewal for the SRCSD's Sacramento Regional Wastewater Treatment Plant (SRWTP), and renewal of its Clean Water Act (CWA) Section 316(a) exceptions to the State's thermal objectives. The State's thermal objectives that are applicable to the Sacramento River at Freeport (the location at which the SRWTP discharges to this river) are contained in its *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Water and Enclosed Bays and Estuaries of California* (Thermal Plan). I also participated in the July 22, 2010, meeting with SRCSD, Regional Water Board, National Marine Fisheries Service (NMFS), and U.S. Fish & Wildlife Service (USFWS) staff and the August 2, 2010, meeting with SRCSD, NMFS and USFWS staff to discuss the technical basis of the Thermal Plan Exception Report, its findings, and recommendations.

Below, I provide analysis and conclusions addressing the following five topics:

- 1) my role as an expert that prepared the Thermal Plan Exception Report,

- 2) findings based on the Thermal Plan Exception Report, which serve as the technical basis for SRCSD's requested Thermal Plan exceptions and alternative effluent limitations,
- 3) SRCSD's request for use of daily average vs. instantaneous measurements for implementation of the alternative effluent temperature limitation,
- 4) the need for and utility of the USFWS and NMFS-requested fish behavior studies at the SRWTP discharge location prior to granting revised Thermal Plan Exceptions, as requested by SRCSD, and
- 5) other issues raised by the USFWS and NMFS in their letters to the Regional Water Board addressing SRCSD's NPDES permit renewal.

My analysis and conclusions are based on my personal knowledge of the lower Sacramento River and Sacramento-San Joaquin Delta (Delta), knowledge of physical habitat requirements of lower Sacramento River and Delta fishes, the thermal effects of the SRWTP discharge on the Sacramento River, and the behavior of resident and anadromous fishes as it relates to the SRWTP diffuser and the thermal effects that its discharge has on the Sacramento River at and downstream of the diffuser location.

PRIOR WORK ASSOCIATED WITH THE THERMAL PLAN AND ITS APPLICATION TO THE SRWTP DISCHARGE

I was the principal author of the Aquatic Biological Resources Chapter included in the SRCSD's *Draft Environmental Impact Report for the Sacramento Regional County Sanitation District: Sacramento Regional Wastewater Treatment Plant 2020 Master Plan* (State Clearinghouse Number: 2002052004) (Draft EIR), which was issued for public review in August 2003. The Aquatic Biological Resources chapter evaluated the thermal effects of the SRWTP discharging 218 mgd (ADWF) on the aquatic resources of the lower Sacramento River and Delta. For this work, I evaluated the scientific basis of the state's Thermal Plan objectives, and the appropriateness of their direct application to the SRWTP discharge for purposes of making the environmental assessment (i.e., thermal effects of the discharge on aquatic life beneficial uses) and the proper California Environmental Quality Act (CEQA) impact determination for the thermal effects of the project. Among other things, the analysis concluded: "...the Thermal Plan objectives are not based on the current science regarding thermal effects of the SRWTP discharge on anadromous salmonids and other aquatic biota using the lower Sacramento River. Consequently, a thorough technical assessment, using the available scientific literature, was performed to determine the potential for project-specific and cumulative thermal impacts to aquatic resources." This remains my opinion.

In other words, because the Thermal Plan objectives are not based on current scientific understanding of thermal effects on resident and anadromous fishes, and because there is no site-specific context to the objectives, exceedances of the objectives at the SRWTP outfall could not automatically be equated with ecological harm to the aquatic communities of the lower Sacramento River and Delta. Rather, a detailed scientific assessment was needed to determine how the increased thermal loading from the SRWTP, due to the project, would affect aquatic

resources. Similarly, a detailed scientific assessment is needed to evaluate effects of the currently permitted discharge.

The Thermal Plan objectives, identified in section 5.A of the Plan, are as follows.

- (1) Elevated temperature waste discharges shall comply with the following:
 - a. The maximum temperature shall not exceed the natural receiving water temperature by more than 20°F.
 - b. Elevated temperature waste discharges either individually or combined with other discharges shall not create a zone, defined by water temperatures of more than 1°F above natural receiving water temperature, which exceeds 25 percent of the cross-sectional area of a main river channel at any point.
 - c. No discharge shall cause a surface water temperature rise greater than 4°F above the natural temperature of the receiving waters at any time or place.
 - d. Additional limitations shall be imposed when necessary to assure protection of beneficial uses.

Objective 5.A.(1)a is established for regulatory purposes, yet it lacks any scientific basis when applied and thus appears rather arbitrary. The 20°F effluent-river differential is applied to point-source discharges universally, regardless of whether it is a large discharge into a low-flow channel or a small discharge into a high-flow channel. Compliance with this objective does not equate with adequate protection of aquatic resources in all cases, nor does exceedance of this objective always equate with ecological harm. Adequate protection of aquatic resources must be determined through site-specific scientific assessments.

Objective 5.A.(1)b restricts thermal effects to no more than 1°F above natural receiving water temperature, which exceeds 25 percent of the cross-sectional area of a main river channel at any point. In reality, the Sacramento River at Freeport (i.e., upstream of any thermal loading from the SRWTP discharge) varies by 1°F or more from bank to bank and/or surface to bottom during much of the year, and such minor temperature differentials within the river channel have negligible, if any, effect on fish movement at this location. Objective 5.A.(1)c, again, establishes an arbitrary cap on the amount of temperature change allowed at the water's surface. The relevance of this change (to the protection of aquatic resources) must be determined site-specifically and seasonally.

Based on my prior evaluation of the Thermal Plan objectives, and my further evaluation as presented in the Thermal Plan Exception Report, my expert opinion is that the existing Thermal Plan objectives are more stringent than necessary to assure the protection and propagation of a balanced, indigenous aquatic community in the lower Sacramento River and Delta. The Thermal Plan Exception Report proposes alternative effluent and receiving water limitations based on a scientific, site-specific assessment that, when complied with, would assure the protection and propagation of a balanced, indigenous aquatic community in the lower Sacramento River and

Delta. The approach, key findings, and conclusions of the Thermal Plan Exception Report are discussed further in the next section.

FINDINGS AND CONCLUSIONS FROM THE THERMAL PLAN EXCEPTION REPORT

I am the principal author of the Thermal Plan Exception Report and the analyses contained in it are accurate to the best of my knowledge. The findings and conclusions presented below, which are based on the Thermal Plan Exception Report, are mine and are accurately stated.

Report Purpose

The purpose for preparing the Thermal Plan Exception Report was to: 1) identify the need for Thermal Plan exceptions, 2) propose appropriate alternative effluent/receiving water NPDES permit limitations, and 3) provide current technical information justifying the proposed exceptions for the SRWTP discharge into the Sacramento River at Freeport. Specifically, the Thermal Plan Exception Report addresses the following key items that must be addressed in order to obtain a CWA Section 316(a) exception.

- Identification and description of the Sacramento River and its aquatic resources.
- Identification of representative important species in the indigenous Sacramento River aquatic community.
- Review and development of information to define the thermal requirements necessary to protect and propagate a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made (i.e., Sacramento River).
- Determination of whether the existing temperature limitations are more stringent than necessary to assure the protection and propagation of a balanced, indigenous aquatic community in the Sacramento River.

Assessment Approach

The approach employed for this assessment involved the following step-wise evaluations. First, representative important fish and benthic macroinvertebrate species in the indigenous Sacramento River aquatic community were identified for assessment purposes. Second, the geographic and thermal nature of the plume within 700 ft (downstream) of the diffuser was characterized for the maximum permitted discharge rate of 181 mgd (average dry weather flow (ADWF)) and a range of critical Sacramento River flow and effluent-river temperature differential conditions that could occur during each month of the year. In addition, the effect of the requested exceptions on the fully mixed river temperature was determined. Third, thermal exposures of fish and benthic macroinvertebrates were assessed based on the thermal conditions in the river downstream of the discharge that would occur under the requested exceptions and proposed alternative effluent/receiving water NPDES permit limitations. The exposure scenarios assessed for the various fish species and invertebrates evaluated were based on the expected behaviors of each organism when moving past the plume, either as an upstream or downstream migrant or when moving locally as a resident species. Thermal effects were thus assessed based on both absolute temperatures encountered within the plume as well as the temperature gradients

(i.e., temperature differences) encountered, and the period of time that organisms would be exposed to elevated temperatures prior to moving into areas of the river where thermal conditions were less affected, or not affected at all. In so doing, the Thermal Plan Exception Report addressed the following three potential effects on migratory fishes, including delta smelt.

- Blockage/significant delay of upstream spawning migrations of adult fish, particularly anadromous salmonids, caused by the near-field thermal plume that exists immediately downstream of the diffuser.
- Population-level effects resulting from mortality in fish caused by acute (short-term) exposure to near-field elevated water temperatures when moving past the diffuser.
- Population or community-level effects on fish resulting from increased river temperatures upon the SRWTP effluent becoming fully mixed with Sacramento River water (i.e., far-field thermal effects).

Technical Findings

The following is a brief summary of my key technical findings, which are presented and discussed in greater detail in the Thermal Plan Exception Report.

Near-Field:

- A 75-100 ft-wide zone of passage occurs along the west bank of the river between the last diffuser port and the west bank. Closing 25 of the 99 ports in 2007 increased the zone of passage along the east bank from 75-100 ft to 175-200 ft, for a combined total (east and west bank) zone of passage of 250-300 ft. These two passage zones comprise between approximately one-third and one-half of the river's 600 ft-width at the diffuser's location.
- There also exists a zone of passage above the diffuser within the upper portion of the water column because the diffuser discharges effluent from the river bottom. By the time the effluent plume reaches the surface, temperatures differ little (i.e., by a few degrees or less) from river background.
- Numerous studies have shown that fish, when presented with a range of temperatures, will seek a temperature that is preferred, and will not submit themselves to temperatures sufficiently high to cause adverse physiological effects when given options (Cherry et al. 1975, Gray et al. 1977, Biro 1988).
- Fish species such as Chinook salmon, steelhead, splittail, delta smelt, and striped bass that typically move through the upper half of the water column when immigrating to upstream spawning areas have a substantial zone of passage to immigrate through that is either minimally affected or not affected at all, thermally, by the discharge.
- Fish species such as white sturgeon, green sturgeon, hardhead, American shad, Pacific lamprey, and river lamprey move through the middle or lower portions of the water column when immigrating to upstream spawning areas. When these adult fish that are moving lower in the water column approach the diffuser, they could encounter unfavorably high water temperatures. These fish would either move laterally within the

river channel until they encounter either more tolerable temperatures or the unaffected zone of passage along one or the other shorelines, or they would move up higher in the water column seeking more favorable temperatures. In doing the latter, they could continue along a mid-channel migration route that would expose them to temperatures less different, or even no different, from river background. In either case, should fish “drift” back toward the affected area of the plume before passing the diffuser, the same behavioral response would be repeated until the fish was past the SRWTP diffuser.

- Fish species with actively swimming emigrants (out-migrating juveniles) include Chinook salmon, steelhead, white sturgeon, green sturgeon, Pacific lamprey, and river lamprey. Emigrating juveniles of these and other species with actively swimming emigrants would be presented with suitable migrations routes where river temperatures are either not affected or negligibly affected by the plume.
- Young-of-the-year fishes that passively drift in the water column and young fishes that are weak swimmers include post-emergent Chinook salmon fry, American shad, striped bass, splittail, hardhead, and delta smelt and many of the resident fishes occurring in the lower Sacramento River. Larvae of these species are typically transported in the upper portions of open waters and along riverbank areas (Wang 1986, Emmett et al. 1991, Moyle 2002). Consequently, the early life stages of these fishes would primarily move through the zones of passage that are minimally affected or unaffected by the SRWTP discharge that exist along the river margins and in the upper one-third of the water column. In the event that drifting larval fishes, such as striped bass, American Shad, delta smelt, splittail or hardhead do drift through the plume, they would be exposed to a gradient of temperature differentials for less than 10 minutes. This would result in a thermal exposure scenario that would not be expected to cause adverse thermal effects to the larval stages of these species.

Far-field:

- The probability with which any given fully mixed Sacramento River temperatures would occur would not change substantially whether the SRWTP is operated to meet the: 1) Thermal Plan objective 5.A.(1)a at all times, year-round, 2) current exception to this objective (i.e., 25°F differential), or 3) proposed exception (i.e., 25°F differential October through March on a daily average basis, thereby allowing up to a 28°F differential on an instantaneous basis at frequency and duration that has occurred historically). This same finding (i.e., probability with which any given fully mixed Sacramento River temperatures would occur would not change substantially) was made when I assessed dry and critical years and when I assessed the 1987 through 1991 drought period.
- The primary reason for the finding made in the previous bullet (above) is that the river temperature, which remains the same for all three scenarios, strongly governs the fully mixed temperature. In addition, most of the time the actual temperature differentials that occur are less than 20°F and, therefore, would be the same under the three scenarios defined above. When the temperature differentials are greater than 20°F, only a small percentage of those occasions have differentials that approach 25°F and extremely rarely do differentials exceed 25°F.

Conclusions

The following is a summary of my conclusions, based on the Thermal Plan Exception Report.

- 1) Adult fish that immigrate past the diffuser on upstream spawning migrations, and resident species moving upstream past the diffuser, would be presented with in-river conditions under the proposed Thermal Plan exceptions that provide an adequate zone of passage during all months of the year for the current permitted capacity of 181 mgd ADWF. Consequently, the thermal conditions in the river under the requested Thermal Plan exceptions and associated alternative effluent/receiving water limitations would not block or significantly delay the upstream passage of adult fishes.
- 2) A thermally tolerable zone of passage exists for all actively swimming fish species that pass the diffuser during their downstream migrations. The thermal gradient (including maximum temperatures) that could occur within the plume area does not possess characteristics that would cause lethality to passively drifting young-of-the-year fishes, due to plume geographic and thermal characteristics and the associated short duration of exposure to elevated temperatures when passing the plume. In no case would the thermal plume cause lethality to emigrating fishes or otherwise be expected to have adverse population- or community level effects to the anadromous or resident fishes occurring in the lower Sacramento River under a permitted capacity of 181 mgd ADWF discharge rate and the proposed Thermal Plan exception conditions.
- 3) The requested Thermal Plan exceptions would not change the relative frequency with which specified fully-mixed river temperatures would occur in the lower Sacramento River/Delta compared to that which occurs under existing conditions (under the existing exceptions) or that which would occur under year-round compliance with the Thermal Plan objective 5.A.(1)a. Consequently, no population or community-level effects on fish or benthic macroinvertebrates would occur from increased river temperatures upon the SRWTP effluent becoming fully mixed with Sacramento River water (i.e., far-field thermal effects).
- 4) The requested Thermal Plan exceptions would not adversely affect the existing balanced, indigenous fish or BMI communities of the lower Sacramento River or Delta. As such, implementation of the proposed alternative effluent and receiving water limitations associated with the proposed Thermal Plan exceptions would assure the protection and propagation of a balanced, indigenous aquatic community in the lower Sacramento River and Delta. For all of the same reasons stated above, this conclusion also applies to the Thermal Plan exception in the existing permit and as proposed in the tentative permit.

REQUEST FOR USE OF DAILY AVERAGE VS. INSTANTANEOUS MEASUREMENTS FOR IMPLEMENTATION OF THE ALTERNATIVE EFFLUENT TEMPERATURE LIMITATION

The proposed exception to Thermal Plan objective 5.A(1)a states that the daily average temperature of the effluent not exceed the daily average natural receiving water temperature by more than:

- 20°F April 1-September 30, and
- 25°F October 1-March 31

A daily average time-step is proposed because the difference between the daily average and the daily maximum effluent-river temperature differential is sufficiently small in each month of the year that use of daily average for the 20°F and 25°F differentials provides adequate protection of aquatic life uses. In addition, use of daily average enables the 20°F and 25°F limitations to be effectively used, operationally, by the SRWTP. When stipulated as daily maximums, operational actions such as diversions to emergency storage basins must occur at temperature differentials lesser than 20°F and 25°F in order to assure that the limitations are never exceeded, even for minutes. It is my understanding that excessive use of emergency storage basins to meet more stringent than necessary thermal effluent limitations reduces the ability to use the emergency storage basins for their intended use. This may actually increase the overall potential for discharges to adversely affect aquatic resources of the lower Sacramento River and Delta. In my opinion, the instantaneous maximum approach to implementing these alternative effluent limitations is more stringent than necessary to assure the protection and propagation of a balanced, indigenous aquatic community in the Sacramento River.

NEED FOR AND UTILITY OF THE USFWS-REQUESTED FISH BEHAVIOR STUDIES TO ADDRESS DELTA SMELT CONCERNS

On August 18, 2010, the USFWS issued a letter to Ms. Kathleen Harder of the Regional Water Board regarding recommendations on the SRCSD State Thermal Plan exception request and NPDES permit renewal. Among other things, the letter states (p. 2, paragraph 6): *“The information provided [in the Thermal Plan Exception Report] supports the District’s conclusion that their current modeled thermal discharge does not impact the beneficial use criteria for the lower Sacramento River.”*

The USFWS letter goes on to state (p. 3, paragraph 1): *“The type of information needed to evaluate the effects of the proposed thermal exception on delta smelt is not present in the analysis, nor is any information about smelt behavior or its susceptibility to such conditions available in the existing body of science. The analysis provides consideration for anadromous fish passage as well as population and community level effects. But what is omitted is analysis of potential effects on migrating adult delta smelt during the winter months and larvae during the spring.”* I disagree with these statements. The Thermal Plan Exception Report assesses delta smelt as well as anadromous salmonids. (See Thermal Plan Exception Report pp. 22, 32-34, 36-37, and 39.) A summary of the delta smelt assessments is provided below.

Adult delta smelt typically move through the upper half of the water column when immigrating to upstream spawning areas. At 60 ft downstream of the diffuser, where internal plume temperatures can show substantial differences from river background, particularly under the “worst-case” scenario assessed in the Thermal Plan Exception Report, the upper half of the water column is unaffected by the plume. Within 175 ft of the diffuser, the plume minimally affects the upper one-third of the water column. At 700 ft downstream of the diffuser (the lower boundary of the model used), a substantial portion of the water column is either unaffected or negligibly affected thermally by the effluent plume.

Numerous studies have shown that fish, when presented with a range of temperatures, will seek a temperature that is preferred, and will not submit themselves to temperatures sufficiently high to cause adverse physiological effects when given options (Cherry et al. 1975, Gray et al. 1977, Biro 1998). Adult delta smelt typically move through the upper half of the water column when immigrating to upstream spawning area. Based on these facts, and the plume dynamics simulated within the river channel under the broad range of conditions, it is my opinion that adult delta smelt would be presented with an adequate zone of passage during all months of the year under the current permitted capacity of 181 mgd ADWF discharge rate and the resultant conditions that would occur under the proposed Thermal Plan exceptions.

Early life stages of delta smelt emigrating past the diffuser are expected to be passively drifting larval stages (fry). Following hatching in upstream spawning areas delta smelt larvae are typically transported downstream near the surface of the water column by currents to zones of freshwater/saltwater mixing (Wang 1986; CDWR and Reclamation 1994). The fish’s ability to swim increases in the days and weeks following emergence, thereby allowing the fish the ability to maintain a preferred position in the water column. Consequently, the early life stages of delta smelt would primarily move through the zones of passage that are minimally affected or unaffected by the SRWTP discharge that exist in the upper one-third of the water column. In the event that drifting delta smelt larvae do drift through the plume, they would be exposed to a gradient of temperature differentials for less than 10 minutes. Available scientific information indicates that such an exposure would not cause adverse thermal effects to delta smelt larvae. Based on these considerations, it is my opinion that adverse effects will not occur.

The USFWS letter recommends that the exception outlined in the 2000 permit should be retained and no further exception be granted, and additionally requests that SRCSD initiates studies to characterize fish behavior in the affected river reach to determine how fish behave in response to the discharge field. However, there is nothing in the letter that: 1) recognizes or technically refutes the delta smelt specific assessments in the Thermal Plan Exception Report cited and summarized above, or 2) identifies or evaluates the very minor differences in thermal plume characteristics that only occasionally occur between the current exceptions the USFWS recommends and the SRCSD’s requested exceptions. In fact, the thermal plume characteristics in the river under the current exceptions and the SRCSD’s requested exceptions are identical the vast majority of the time.

The USFWS letter raises the need for fish behavioral studies. This does not refute the technical findings of the Thermal Plan Exception Report, which technically justifies the requested exceptions consistent with CWA Section 316(a) requirements. Moreover, the USFWS letter

does not specifically identify how the requested fish behavioral studies will produce information that would enable regulators to determine whether protection of aquatic resources differs meaningfully between operations compliant with the existing exceptions vs. the proposed exceptions. Because thermal conditions within the plume are identical under the existing exceptions and the proposed exceptions the vast majority of the time, and because the probability with which downstream fully mixed river temperatures would occur between the two scenarios is effectively the same, it is my expert opinion that a hydroacoustic study would not produce information useful in differentiating the level of aquatic life protection between operating the SRWTP to meet the existing exceptions vs. the proposed exceptions.

OTHER ISSUES RAISED IN THE USFWS AND NMFS LETTERS

Synergistic Effects

On page 4, paragraph 2, the USFWS letter states: *"There has not been an analysis linking the synergistic effects of multiple pollutants, like chemical and thermal contamination, on the aquatic organisms in the Sacramento River."* The NMFS letter (p. 6) also indicates that synergistic effects of multiple pollutants should be assessed.

The NPDES permit for the SRWTP requires both acute (weekly 96-hour flow-through) and monthly chronic three-species bioassay testing using undiluted effluent and serial dilutions with upstream receiving water, unless the receiving water is toxic. These bioassays are designed to assess synergistic effects of multiple pollutants in the effluent and receiving water. Bioassay requirements effectively address the toxicity testing recommendations made in the USFWS and NMFS letters, in a traditional manner, and thus implementing the USFWS bioassay study recommendations would be redundant. Certain of these standardized bioassays that are required by the renewed permit could be performed at specific temperatures that correspond to river temperatures within the plume, as warranted.

Predation

On page 4, paragraph 3, the USFWS letter states: *"Thermal discharges have the potential to create winter thermal refugia for fish species that do better in warmer temperatures, specifically non-native predators. Local aggregations of predatory fish are of specific concern for listed fish species. ...Whether or not predators aggregate in the zone of elevated water temperature needs to be evaluated."*

On page 3, paragraph 5, the NMFS letter states: *"...the area of thermal mixing at the diffusion outfall has a distinct potential to attract non-native predators of the aforementioned listed species."*

In consideration of these comments, it must be noted that the attraction of predatory fish to the warmer water being discharged from the SRWTP diffuser, should such attraction occur, will occur whether this facility is required to comply with the Thermal Plan objectives, the existing exceptions, or the requested exceptions. The very minor differences in thermal plume characteristics that could occur under these three regulatory scenarios (i.e., compliance with the

Thermal Plan, existing exceptions, and the proposed exceptions) would not be sufficiently large to attract predatory fish under once scenario, but not the other. If predatory fish are attracted to the warmer plume, they will be attracted even if the discharge met the Thermal Plan objectives at all times, as a 20°F differential is more than sufficient to influence fish behavior, should fish behavior be affected by temperature at this site. The other reason predatory fish may hold at the outfall site is because they can hold in areas of hydraulic breaks associated with the diffuser structure itself – just as predatory fish often hold on the downstream side of bridge abutments, snags, boulders or other in-channel structure. Thus, the issue of predatory holding at the outfall is a separate and distinct issue from that of whether the requested Thermal Plan exceptions have been adequately justified with regards to direct thermal effects, and thus whether they can be permitted at this time. If the agencies desire a fish behavior study, they should determine whether the studies they desire can provide the specific information that would be needed to better evaluate the protectiveness of the requested exceptions, relative to the existing exceptions. It is my expert opinion that a hydroacoustic fish study at the site would be informative with regards to how fish (e.g., predatory fishes) utilize the site and how other species move pass the diffuser, but will not produce information that can differentiate fish behavior between conditions that exist under the current exceptions vs. conditions that would exist under the proposed exceptions or that can differentiate between existing or proposed exceptions and direct application of the Thermal Plan.

Finally, on page 5, bullet 1, the USFWS letter states: *“An evaluation using hydroacoustic technology to determine if there are aggregations of large fish or schools of small fish in the zone of elevated water temperature that are atypical compared to other nearby mid-channel river reaches.”*

On page 3, paragraph 5, the NMFS letter states: *“If the interface between the effluent from the diffuser and receiving water, and the proximal area downstream is shown to have a greater concentration of predators than nearby portions of the Sacramento River that do not have similar structures and thermal mixing, it may be reasonably assumed that the action provides an aggregating point for predation.”*

In addressing these comments, it should be noted that fish distribution and abundance within the Sacramento River at any given site is affected by season, time of day, water temperature, river discharge, current velocity, turbidity, dissolved oxygen levels, channel bathymetry, in-channel structure, presence of other fishes, benthic macroinvertebrates, and other factors. At the SRWTP outfall, not only temperature would affect fish use of the site, but also the physical structure of the diffuser itself, the unique channel bathymetry, and the other factors cited above. Thus, it would be inappropriate to attribute differences in fish aggregations at the SRWTP outfall site and “nearby mid-channel river reaches,” to temperature alone, unless all the other physical habitat characteristics were the same. Simple comparisons of this nature are confounded by the other physical variables that also change between sites, and thus inferences drawn regarding thermal effects may be invalid. In my opinion, merely comparing fish aggregations at this site to others, which we know will differ due to many variables and the unique physical conditions of the SRWTP site, would not address whether the SRWTP outfall site conditions adversely impact specific fish species using or passing the site.

LITERATURE CITED

- Biro, P.A. 1998. Staying cool: behavioral thermoregulation during summer by young-of-year brook trout in a lake. *Transactions of the American Fisheries Society* 127:212-222.
- CDWR (California Department of Water Resources) and Reclamation (U.S. Bureau of Reclamation). 1994. Biological Assessment: Effects of the Central Valley Project and State Water Project on Delta Smelt and Sacramento Splittail. U.S. Fish and Wildlife Service, Ecological Services, Sacramento Field Office.
- Cherry, D.S., K.L. Dickson, and J. Cairns Jr. 1975. Temperatures selected and avoided by fish at various acclimation temperatures. *J Fish Res Bd Can.* 32:485-491.
- Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries, Volume II: Species Life Histories Summaries. ELMR Report No. 8. NOAA/NOS Strategic Environmental Assessments Division. Rockville, MD.
- Gray, R.H., R.G. Genoway, and S.A. Barraclough 1977. Behavior of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) in relation to simulated thermal effluent. *Trans Am Fish Soc.* 106 (4): 366-370.
- Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley and Los Angeles, CA.
- USFWS (U.S. Fish and Wildlife Service). 1995. Working paper on restoration needs. Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. Vol. 2. USACE. Stockton, CA.
- Wang, J. 1986. Interagency Ecological Program Technical Report #9. January 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories.

Michael D. Bryan, Ph.D.
Partner / Principal Scientist

Dr. Michael Bryan has over 23 years of combined consulting and research experience addressing how physical, chemical, and biological characteristics of aquatic habitats affect fish and other aquatic life. Dr. Bryan's primary areas of technical expertise are fisheries biology/aquatic ecology and aquatic toxicology/water quality. Dr. Bryan also has extensive expertise in CEQA/NEPA documentation, CVP/SWP operations, study design and management, data compilation and analysis, and permitting—particularly municipal wastewater NPDES permitting.

Dr. Bryan applies his expertise to assist clients with strategic planning; compliance monitoring, technical evaluations; project refinement, permitting, and implementation; and, when needed, expert witness testimony. His primary professional focus is water quality and fisheries biology. Dr. Bryan has extensive experience in working with CVP/SWP operations modeling and using modeling output to assess impacts to fish resources and water quality in the American River, Sacramento River, and Delta system. Currently, Dr. Bryan is working with numerous municipal wastewater dischargers to assist in renewing their NPDES permits and to maintain compliance with those permit. Also, he is working with Central Valley Regional Water Quality Control Board, State Water Resources Control Board, and U.S. EPA staff to process region-wide amendments to the Central Valley Water Quality Control Plan (Basin Plan).

EDUCATION Ph.D., Environmental Toxicology & Fisheries Biology, 1993, Iowa State University

M.S., Fisheries Biology, 1989, Iowa State University

B.S., Fisheries Biology & Biology, 1986, University of Wisconsin, Stevens Point

**REPRESENTATIVE
PROJECT
EXPERIENCE**

NPDES PERMITTING / WATER QUALITY / WASTEWATER STUDIES

NPDES PERMITTING

Providing technical and strategic services to review, evaluate, and negotiate waste discharge requirements in tentative NPDES permits for wastewater treatment plants (WWTPs) issued by the RWQCB, develop and conduct special studies, and assess impacts of discharges. Developing technical reports, written comments, and strategic guidance for addressing NPDES permit issues. Assisting clients in preparing written comments on tentative permits upon renewal by RWQCB. Leading NPDES permit negotiation meetings with RWQCB, California Department of Fish and Game, NOAA Fisheries, and Department of Health Services staff on behalf of the dischargers.

These services have been provided for:

- El Dorado Irrigation District – Deer Creek and El Dorado Hills WWTPs (1996–present)
- Sacramento Regional County Sanitation District (1997–present)
- City of Roseville – Dry Creek and Proposed Pleasant Grove Creek WWTPs (1998–present)

Michael D. Bryan

- County of Placer – Sewer Maintenance District No. 1, Sewer Maintenance District No. 3, Sheridan, Applegate (1998–present)
- City of Vacaville (1999–present)
- City of Placerville – Hangtown Creek WWTP (1999–present)
- City of Brentwood – Brentwood WWTP (2003–present)
- County of Nevada – Lake Wildwood, Lake of the Pines, and Cascade Shores WWTPs (2003–present)
- Mountain House Community Services District (2006–present)
- Ironhouse Sanitary District (2006–present)
- City of Stockton (2008–present)
- Colusa Industrial Properties (2007–2008)
- City of Santa Rosa (2005–2007)
- Los Angeles County Sanitation Districts – Los Coyotes Water Reclamation Plant and Long Beach Water Reclamation Plant (2002–2005)
- City of Lincoln/Del Webb – new Lincoln Wastewater Treatment and Reclamation Facility (2000–2005)

THERMAL PLAN EXCEPTIONS

Currently assisting the Sacramento Regional County Sanitation District with obtaining a continued exception to the Thermal Plan objectives for the Sacramento Regional Wastewater Treatment Plant discharge, as part of NPDES permit renewal (Client: SRCSD, Larry Walker Associates; ongoing).

Dr. Bryan acted as project lead for the State of California, Department of General Services (DGS) in conducting a study of the temperature-related effects on migrating fish of its Central Heating and Cooling Plant (Central Plant) discharges to the Sacramento River, and to assist DGS in reaching a cost-effective solution to its current temperature compliance issue. As required by the DGS NPDES permit, RBI prepared a thermal effects study work plan and obtained review and approval of the plan by NOAA Fisheries, CDFG, and USFWS. RBI completed the study and issued its report to the agencies and the RWQCB.

Based on this study, its finding, and concurrency on findings by the fish agencies, the RWQCB issued a Thermal Plan Exception to DGS for its plant, as allowed under Section 316(a) of the Clean Water Act.

SEASONAL COLIFORM BACTERIA LIMITATIONS

Successfully negotiated alternative winter coliform bacteria limits for the Deer Creek NPDES permit. Project involved extensive technical analyses, technical report preparation, and negotiations with RWQCB policy and permitting staff and DHS technical staff. (Client: El Dorado Irrigation District, 2000–2002).

Provided similar services to successfully negotiate, with DHS, alternative winter coliform bacteria limitations for Sewer Maintenance District No. 1 NPDES Permit.

Michael D. Bryan

**PORT OF STOCKTON STORMWATER ADMINISTRATIVE ORDER ON CONSENT
NEGOTIATION AND TOXICITY MONITORING REVIEW**

Developed and negotiated stormwater toxicity monitoring requirements in the U.S. EPA's Administrative Order to achieve reasonable and scientifically defensible requirements. Technically reviewed and interpreted bioassay laboratory reports from stormwater monitoring events in support of maintaining compliance with the Order. Directed toxicity identification evaluations (TIEs), when needed.

COPPER WATER-EFFECT-RATIO (WER) STUDY

Principal-in-charge of a copper water-effect ratio (WER) study for the Deer Creek WWTP, to address the WWTP's copper compliance issue. Study is being conducted according to the U.S. EPA's *Streamlined Water-Effect Ratio Procedure for Discharges of Copper* (EPA-822-R-01-005).

RECEIVING WATER DISSOLVED OXYGEN STUDIES

As project manager, evaluated the effects of effluent discharges on downstream dissolved oxygen profiles using U.S. EPA's STREAMDO IV model. Studies conducted on Deer Creek (Client: El Dorado Irrigation District, 1997-98) and Old and New Alamo Creeks, and Ulatis Creek.

RECEIVING WATER TEMPERATURE STUDIES

Project manager and technical lead on projects conducted to evaluate seasonal temperature regimes and compliance with receiving water limitations stipulated in NPDES permits. Developed work plan, managed field staff, and managed preparation of study reports submitted to the Central Valley RWQCB.

- Deer Creek (Client: El Dorado Irrigation District, 1997-2001)
- Hangtown Creek (Client: City of Placerville, 1998-99; 2002-present)
- Old and New Alamo Creeks (Client: City of Vacaville, 2001-present)
- Marsh Creek (Client: City of Brentwood, ongoing)
- Sacramento River (Clients: SRCSD, California Department of General Services)

EFFLUENT AND RECEIVING WATER QUALITY ASSESSMENTS

Principal-in-charge on effluent and receiving water quality assessments for six wastewater treatment plants in the Central Valley of California, including: Deer Creek and El Dorado Hills WWTPs (El Dorado Irrigation District), Hangtown Creek WWTP (City of Placerville), Sheridan WWTP, Sewer Maintenance District No. 1 and No. 3 WWTPs (Placer County). Projects documented effluent and receiving water concentrations of over 180 constituents, including all California Toxics Rule/National Toxics Rule constituents, to determine whether contaminant-specific waste discharge requirements are warranted in the WWTPs' NPDES permits.

Michael D. Bryan

SOUTH FORK AMERICAN RIVER WATERSHED ASSESSMENT

Principal-in-charge responsible for compilation and evaluation of available water quality data collected in the South Fork American River watershed. Project used a Geographic Information Systems (GIS) approach to prioritize sub-basins within the watershed for future water quality monitoring and restoration.

SEDIMENT TOTAL MAXIMUM DAILY LOAD (TMDL)

Project manager and technical lead for providing fisheries and water quality expertise to assist the Imperial Irrigation District with participating in the development of a silt TMDL for the Alamo River, the main tributary to the Salton Sea, Imperial Valley, California. Using available scientific literature, characterized the effects of silt (i.e., suspended sediments) on freshwater aquatic life. Reviewed and provided comments on the Draft Problem Statement prepared by the Colorado River Basin RWQCB.

EFFLUENT DISCHARGE IMPACT ASSESSMENT

Project manager and technical lead on project conducted to evaluate the potential impacts to human health and aquatic life from discharging tertiary-treated municipal effluent into Folsom Reservoir or Lake Natoma, as part of dry year water conservation measures under the Sacramento Areas Water Forum Proposal. Wrote technical report outlining evaluation findings. Met with DHS staff to discuss the proposed action and its potential effects on human health associated with downstream M&I diversions.

ECOLOGICAL, WATER QUALITY, AND HYDROLOGIC EVALUATION OF DEER CREEK

Project manager and technical lead on study documenting the ecological, water quality, and hydrologic conditions of Deer Creek upstream and downstream of the Deer Creek WWTP. Conducted reconnaissance survey, developed experimental approach, and supervised/participated in field data collection. Documented fish and benthic macroinvertebrate taxa. Prepared final project report, which served, in part, as the basis for renewal of the WWTP's NPDES permit.

WATER QUALITY IMPACTS OF TCD OPERATION AT FOLSOM DAM

Project manager and technical lead for assessing the potential impacts of operating a temperature control device (TCD) at the urban water supply intakes at Folsom Dam. Identified seasonal impacts to Lower American River water temperatures and fish resources, and the quality of raw and finished urban water supplies diverted from Folsom Dam and the Lower American River. Presented findings to water purveyors and the U.S. Bureau of Reclamation staff in several technical meetings.

Michael D. Bryan

SEDIMENT CONTAMINANT MONITORING

Project manager and technical lead for a North American-wide sediment contaminant monitoring survey designed to define the range of polydimethylsiloxanes in surface sediments of marine and freshwater systems receiving large municipal wastewater discharges. Supervised preparation of site-specific sampling plans, developed an experimental approach for the overall project, prepared a comprehensive quality assurance project plan, and contributed to preparation of project reports. Study served as the basis for subsequent bioassays and ecological risk assessments.

ECOLOGICAL RISK ASSESSMENT

Directed the aquatic assessment of component of a probabilistic ecological risk assessment that quantified the potential risk posed to wildlife and aquatic populations from opening and operating a gold mine in northern Washington.

STORMWATER QUALITY MONITORING

Project manager and technical lead for the Laguna West stormwater runoff water quality mitigation-monitoring project, Sacramento County. Developed the experimental design and field operating procedures, statistically analyzed laboratory bioassay and contaminant data, directed activities for field personnel, and wrote project progress and final reports.

BASIN PLAN AMENDMENTS / USE ATTAINABILITY ANALYSES

SITE-SPECIFIC OBJECTIVES – pH, TURBIDITY, AND TEMPERATURE

Principal-in-charge and lead water quality/aquatic ecology specialist on development of site-specific amendments to the Sacramento River and San Joaquin River Basin Water Quality Control Plan (Basin Plan) for Deer Creek pH, turbidity, and temperature. Responsibilities included literature research, technical presentations to CDFG, NOAA Fisheries, USFWS, and RWQCB staff, and preparation of a technical report in support of the proposed site-specific amendments. The Deer Creek objectives for pH and turbidity have been approved by the State and U.S. EPA, and are effective. The temperature amendment was approved by the RWQCB in January 2003, the SWRCB in February 2004, and is currently being reviewed by the Office of Administrative Law. (Client: El Dorado Irrigation District, Central Valley RWQCB).

Currently providing similar technical and strategic services for Central Valley dischargers and RWQCB for obtaining Region-wide Basin Plan amendments for pH and turbidity.

Michael D. Bryan

USE ATTAINABILITY ANALYSIS FOR OLD ALAMO CREEK, NEW ALAMO CREEK, ULATIS CREEK, AND CACHE SLOUGH

Currently leading Use Attainability Analysis (UAA) project for City of Vacaville to modify/de-designate cold aquatic life uses and the municipal use for reaches of New Alamo Creek, Ulatis Creek, and Cache Slough. Previously collected field aquatic ecology, water quality, and physical habitat data for use in a UAA in support of de-designating the cold freshwater habitat and cold migration beneficial uses assigned to Old Alamo Creek. Participated in preparation of the UAA report.

FISHERIES BIOLOGY

BIOLOGICAL ASSESSMENT FOR MOUNTAIN HOUSE COMMUNITY SERVICES DISTRICT NEW MUNICIPAL WASTEWATER OUTFALL IN OLD RIVER

Prepared a Biological Assessment (BA) that addressed the potential effects on ESA-listed anadromous fish species that could result from placing a new diffuser outfall into Old River, and operating the outfall to discharge up to 5.4 mgd of treated municipal effluent into Old River at buildout. Developed conservation measures to be implemented as part of the project to avoid/minimize effects on listed fishes. Worked closely with NOAA fisheries staff and assisted staff in preparing a Biological opinion for the project.

COSUMNES RIVER FLOW AUGMENTATION PROJECT

Lead fisheries consultant on project that provides up to 5,000 acre-feet of American River water, annually, routed through the Folsom South Canal, to pre-wet the lower Cosumnes River channel to provide earlier and more prolonged hydraulic continuity throughout the lower river during the fall-run chinook salmon spawning season. Assessed potential fish resource impacts of implementing the project on the fish resources of the lower American River, Cosumnes River, and Mokelumne River.

PUTAH CREEK FLOW RESTORATION PROJECT

Served as Principal-in-Charge of the Putah Creek fisheries assessment. Determined how the project, developed to address debris buildup below the Putah Creek Diversion Dam through dam and channel modifications, could incorporate elements to achieve a secondary objective of protecting, maintaining, and possibly enhancing Putah Creek's aquatic habitats and fish resources.

HANGTOWN CREEK AQUATIC BIOLOGICAL RESOURCES ASSESSMENT

Principal-in-Charge responsible for developing study design and implementation of fish sampling (electrofishing), benthic macroinvertebrate sampling, habitat assessment, and temperature monitoring. Benthic macroinvertebrate sampling was conducted using the California Department of Fish and Game California Stream Bioassessment Procedure. Study focused on evaluating the thermal effects of the Hangtown Creek Wastewater Treatment Plant's discharge on the aquatic ecology of Hangtown Creek.

Michael D. Bryan

Prepared detailed study report. (Clients: City of Placerville, California Department of Fish and Game, Central Valley RWQCB, 2002-present).

Conducted similar study in Old Alamo Creek and New Alamo Creek in support of Use Attainability Analyses being conducted by the RWQCB and City of Vacaville.

LOWER YUBA RIVER CALFED PROJECT

Co-Principal-in-Charge and technical lead for developing a local-level Implementation Plan for Lower Yuba River anadromous fish habitat restoration. Project involves working with the Lower Yuba River Fisheries Technical Working Group, which has representatives from all state and federal fishery agencies, to perform a comprehensive review of available fishery, ecological, and hydrologic information and to develop a conceptual model for the Yuba River aquatic ecosystem. This model will create a framework to guide the refinement, evaluation, and prioritization of restoration actions proposed by Calfed's Ecosystem Restoration Program Plan, U.S. Fish and Wildlife's Anadromous Fish Restoration Program, California Department of Fish and Game's 1991 Plan, and other fish management plans already developed for the river. The conceptual model will identify testable hypotheses related to key ecosystem processes, habitat conditions, stressors, and fish population trends and behavior, including habitat use. Based on this work, restoration actions, pilot projects, and studies will be prioritized for near-term and long-term implementation in a manner consistent with long-term ecosystem and watershed management goals.

LOWER AMERICAN RIVER OPERATIONS WORKING GROUP PARTICIPANT

Provided technical assistance to staff from U.S. Bureau of Reclamation, California Department of Fish and Game, U.S. Fish & Wildlife Service, and National Marine Fisheries Services in evaluating alternative Folsom Dam shutter operational scenarios for the summer/fall period to maximize thermal benefits to Lower American River fall-run chinook salmon and steelhead, and to balance benefits to these two species.

CDFG/YCWA INTERIM SETTLEMENT AGREEMENT

Initiated and led the development of a California Department of Fish and Game-Yuba County Water Agency (YCWA) Interim Settlement Agreement and Interim Study Plan for the Lower Yuba River. Facilitated negotiations between CDFG and YCWA, which were conducted to reach agreement on several issues, including minimum instream flow, water temperature, and flow fluctuation requirements associated with operation of the Yuba River Development Project. This process ultimately culminated in the Lower Yuba River Accord. The Accord resolved a nearly 20-year legal and political fight over water rights and fisheries flows. The Accord received the State's highest environmental award.

Michael D. Bryan

LOWER AMERICAN RIVER SALMON MORTALITY MODEL DEVELOPMENT

Project manager and technical lead for project that refined the U.S. Bureau of Reclamation's Lower American River early life stage fall-run chinook salmon mortality model. Compiled historic data defining temporal distributions of immigration and temporal and spatial distributions of spawning. Worked with Reclamation computer programmers to make code changes that resulted in an improved model that reflected the best available biological data for the river's fall-run chinook salmon population.

LOWER SACRAMENTO RIVER AND DELTA TRIBUTARIES TECHNICAL TEAM APPOINTEE

Appointed to the Lower Sacramento River and Delta Tributaries Technical Team, as part of the Anadromous Fish Restoration Program of the Central Valley Project Improvement Act. Developed technical reports outlining the key factors currently limiting chinook salmon and steelhead populations in the Lower American and Yuba rivers. Worked cooperatively with California Department of Fish and Game and U.S. Fish and Wildlife Service biologists on the project.

CENTRAL VALLEY PROJECT RESTORATION TECHNICAL LIAISON

Served as a technical liaison between the Northern California Power Agency, a contributor to the Central Valley Project (CVP) Restoration Fund, and the State and federal fish resource agencies charged with applying these funds to restore Central Valley anadromous fish populations. Developed a strategic process for establishing a shared understanding among these and other stakeholders regarding CVP restoration goals, objectives, and criteria for prioritizing expenditures from the CVP Restoration Fund to achieve basin-wide, fish population-restoration goals.

BAY/DELTA FISHERIES REPORT

Prepared a technical report for the Northern California Power Agency that identified the major factors that have contributed to recent declines in San Francisco Bay/Sacramento-San Joaquin Delta fishery resources. The factors contributing to recent declines of anadromous and resident fish populations were ranked according to their relative importance or contribution to observed population declines.

SACRAMENTO SPLITTAIL DISTRIBUTION AND RELATIVE ABUNDANCE STUDY

Project manager and technical lead for a large interagency (Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service), U.C. Davis, State Water Contractors, and Interagency Ecological Program) gill net survey that documented the distribution and relative abundance of Sacramento splittail in the Sacramento and San Joaquin rivers and Delta. Developed the experimental design and field operating procedures for the project, and supervised field personnel. Performed all statistical analyses of catch data, and prepared the project report.

Michael D. Bryan

CEQA/NEPA

EDWPA SUPPLEMENTAL WATER RIGHTS PROJECT EIR

Dr. Bryan is currently directing the development of the Water Quality Section for the El Dorado County Water and Power Authority (EDWPA) Supplemental Water Rights Project EIR. The proposed project is to establish permitted water rights allowing diversion of water from the American River basin to meet planned future water demands in the EID and GDPUD service areas and other areas located within El Dorado County that are outside of these service areas. EDWPA will be filing with the State Water Resources Control Board, Division of Water Rights, petitions for partial assignment of each of State Filed Applications 5644 and 5645, and accompanying applications allowing for the total withdrawal for use of 40,000 AFA, consistent with the diversion and storage locations allowed it under the El Dorado-SMUD Cooperation Agreement.

IRONHOUSE SANITARY DISTRICT WASTEWATER TREATMENT PLANT EXPANSION SUBSEQUENT EIR

Lead consultant for preparing the fishery and aquatic resources chapters of the EIR, which is being prepared by Jones & Stokes for the Iron House Sanitary District. Developed thresholds of significance for chapter for interpreting the effects of anticipated receiving water quality changes on aquatic resources. Addressed ESA issues related to listed fish species.

EASTERN SACRAMENTO COUNTY REPLACEMENT WATER SUPPLY PROJECT

Lead consultant for preparing the water quality and fishery and aquatic resources chapters of the EIR, which is being prepared by EDAW for Sacramento County. Contributed to development of EIR alternatives to be evaluated and developed thresholds of significance for the water quality and fisheries chapters. Performed detailed analysis of effects on American River and tributary water quality and compliance with water quality standards that would result from inputting remediated groundwater into the system. Also assessed effects on fish resources in the American, Cosumnes, and Mokelumne rivers of using up to 5,000 acre-feet of remediated water, annually, to pre-wet the Cosumnes River channel to provide earlier and more prolonged hydraulic continuity throughout the lower river during the fall-run chinook salmon spawning season.

SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT 2020 MASTER PLAN EIR

Lead consultant for preparing water quality and fishery and aquatic habitat chapters of the EIR. Responsible for coordinating all hydrologic and water quality modeling associated with the EIR, and the use of modeled output for impact assessment purposes. Contributed to development of EIR alternatives to be evaluated and thresholds of significance for the water quality and fisheries/aquatic habitat resources. Also assisted in conducting stakeholder and technical workshops associated with development of the 2020 Master Plan.

Michael D. Bryan

AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS FOR pH, TURBIDITY, AND TEMPERATURE AT DEER CREEK, EL DORADO & SACRAMENTO COUNTIES

Co-authored Central Valley Regional Water Quality Control Board's Staff Report and CEQA Functional Equivalent Document for the above-cited Basin Plan amendments, which modify the pH, turbidity, and temperature objectives in Deer Creek.

LONG-TERM REOPERATION OF FOLSOM DAM AND RESERVOIR EIR

Served as fisheries lead on project team to determine the feasibility of indefinitely extending Sacramento Area Flood Control Agency's (SAFCA) Folsom Dam and Reservoir Reoperation Agreement with the U.S. Bureau of Reclamation. Worked closely with modelers to develop PROSIM (hydrologic) simulations to depict hydrologic effects of the project. PROSIM output was input into Reclamation's reservoir and river water temperature models and Sacramento and lower American river salmon mortality models. Output from all these models was assessed to identify project-specific and cumulative impacts to reservoir, river, and Delta fish resources. Additional activities included meeting with National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game to determine the need for consultation under the federal and state Endangered Species Acts and determination of potential impacts to fishery resources throughout the Central Valley Project resulting from integrated reservoir operations.

LAKE OF THE PINES WASTEWATER TREATMENT PLANT UPGRADE EIR

Lead consultant for preparing the water quality/hydrology and fishery and aquatic resources chapters of the EIR, which was prepared by EDAW for Nevada County. Contributed to development of EIR alternatives to be evaluated and developed thresholds of significance for the water quality/hydrology and fisheries chapters. Also assisted in conducting stakeholder and technical workshops associated with development of the facilities Master Plan. Lead consultant for issues related to NPDES permit.

CITY OF CHICO WASTEWATER TREATMENT PLANT EXPANSION EIR

Lead consultant for preparing the fishery and aquatic resources chapter of the EIR, which was prepared by Jones & Stokes for the City of Chico. Contributed to development of EIR alternatives to be evaluated and developed thresholds of significance for the fisheries chapter. Also assisted in refinement of water quality assessments used to make determinations regarding potential impacts to aquatic resources in the Sacramento River. Also prepared a Biological Assessment for project to address potential project construction and operational effects on ESA listed fish species and their habitats.

Michael D. Bryan

DEL WEBB TEHAMA PROJECT

Lead consultant for preparing the fishery and aquatic resources chapter of the EIR, which was prepared by Impact Sciences for Del Webb. Conducted site surveys and habitat characterizations. Consulted with NOAA Fisheries on ESA issues to obtain a concurrence letter of not likely to adversely affect steelhead using adjacent water bodies.

HANGTOWN CREEK WASTEWATER TREATMENT PLANT UPGRADES

Served as Principal-in-Charge for preparing an Initial Study/Mitigated Negative Declaration in support of the City of Placerville's planned upgrades to its Hangtown Creek Wastewater Treatment Plant (HCWWTP). This environmental document was prepared to meet CEQA requirements and to support the City's application to the State of California for a State Revolving Fund loan that will fund, in part, planned improvements HCWWTP.

LOWER CASCADE CANAL MODERNIZATION PROJECT EIR

Served as lead technical consultant for preparing the aquatic biological resources chapter of the EIR. Responsible for conducting detailed fisheries habitat and hydraulic assessments on the Lower Cascade Canal and presenting information to stakeholders as well as incorporating it into the EIR impact assessments. Contributing to development of EIR alternatives to be evaluated and thresholds of significance for determining impacts.

EL DORADO IRRIGATION DISTRICT'S WATER SUPPLY MASTER PLAN EIR

Serving as lead technical consultant for preparing the hydrology, water quality, and aquatic biological resources chapters of the programmatic EIR. Responsible for evaluating Master Plan demands and District operations to meet projected demands to determine how such operations could impact these resources. Providing strategic guidance for integrating other District facilities into the assessment to produce a more real-world assessment.

CITY OF LINCOLN WASTEWATER TREATMENT AND RECLAMATION FACILITY EIR

Provided technical review and oversight for fisheries and aquatic biological resources chapter of EIR. Assisted project team with addressing potential impacts and preparing supplements and addendums to EIR. Consulted with National Marine Fisheries Service on anadromous fish issues, including Endangered Species Act issues, related to new wastewater discharges to Auburn Ravine.

EL DORADO IRRIGATION DISTRICT WASTEWATER TREATMENT PLANT EXPANSION EIR

Lead author for water quality and fisheries sections of EIR. Compiled and assessed effluent and receiving water quality data, evaluated plant's acute and chronic bioassay testing results, and prepared chapters.

Michael D. Bryan

SACRAMENTO AREA WATER FORUM PROPOSAL EIR

The Water Forum process is a coalition of 46 stakeholders representing agriculture, business, public agencies, and environmental groups collectively developing a strategic water-planning platform for the greater Sacramento area. Regularly presented technical information on effects of reservoir operations and water management on fish resources and water quality to the Water Forum. Prepared all fisheries and surface water quality chapters of the EIR. Served as liaison between PROSIM (hydrologic)/water temperature/salmon mortality modelers, Fischer-Delta (water quality) modelers, and other technical staff and CEQA consultants/City-County management staff responsible for preparing the EIR. Contributed to preparation of a Habitat Management Program (HMP) for the Lower American River, in cooperation with several other Water Forum participants. The HMP was designed to preserve the wildlife, fisheries, recreational, and aesthetic values of the Lower American River, as well as mitigate for any potential impacts of the Water Forum Proposal.

NATOMA PIPELINE REPLACEMENT AND FOLSOM WATER TREATMENT PLANT EXPANSION PROJECT EIR/EA

Managed preparation of fisheries sections of the EIR/EA. The project involved analyzing the construction and operational impacts associated with pipeline replacement and water treatment plant expansion, as well as a 7,000 AFA increment of additional water planned to be diverted from Folsom Reservoir. Worked closely with modelers to develop PROSIM (hydrologic) simulations to depict hydrologic effects of the project. PROSIM output was input into Reclamation's reservoir and river water temperature models and Sacramento and lower American river salmon mortality models. Output from all these models was assessed to identify project-specific and cumulative impacts to reservoir, river, and Delta fish resources. The project required compliance with federal and state regulations, including the Endangered Species Act and Clean Water Act.

NARROWS II POWERHOUSE INTAKE EXTENSION MITIGATED NEGATIVE DECLARATION/INITIAL STUDY

Technical lead for assessing the potential effects on the fish resources of Englebright Reservoir and the Lower Yuba River from drawing water into the Narrows II Powerhouse from a lower elevation within Englebright Reservoir as a result of extending the current intake structure. Prepared a technical report on findings, with an emphasis on temperature-related effects on Lower Yuba River anadromous fish resources.

Michael D. Bryan

**PLACER COUNTY WATER AGENCY AND NORTHRIDGE WATER DISTRICT
GROUNDWATER STABILIZATION PROJECT EIR**

Managed preparation of fisheries chapter of the EIR. Analyzed the hydrologic effects of the project as they would affect Folsom Reservoir seasonal storage levels, lower American and Sacramento River flows, and Delta inflow/outflow, and water temperatures, and the potential for such changes to impact fish resources in these water bodies. Worked closely with modelers to develop PROSIM (hydrologic) simulations to depict hydrologic effects of the project. PROSIM output was input into Reclamation's reservoir and river water temperature models and Sacramento and lower American river salmon mortality models. Output from these models was used to assess project-specific and cumulative impacts to reservoir, river, and Delta fish resources.

CVP WATER SUPPLY CONTRACTS EIS/EIR

Lead author for all fisheries and water quality chapter of the joint programmatic EIS/EIR prepared for the Central Valley Project Water Supply Contracts under Section 206 of Public Law 101-514. Evaluated hydrologic, river and reservoir water temperature, and salmon mortality model output to determine potential impacts to CVP reservoir, Lower American River, Sacramento River, and Delta fish resources that could result from diverting a portion of the water from Folsom Reservoir. Worked closely with project engineers to design the hydrologic modeling studies, and to determine output needed to conduct the necessary environmental assessments. Also participated in development and evaluation of project alternatives capable of fulfilling project purposes, with an emphasis on water supply, affected hydrology, and environmental constraints.

HAMILTON CITY PUMPING PLANT FISH SCREEN IMPROVEMENT PROJECT EIR/EIS

Developed technical approach to assessing the effects of the proposed project and its alternatives on fisheries and aquatic habitats. Lead author for all fisheries sections of the EIR/EIS. Fisheries and aquatic habitat chapter received U.S. EPA's highest review score. Key issues included analyses of alternative means of simultaneously protecting fish (including the endangered winter-run chinook salmon) while re-establishing reliability in Glenn-Colusa Irrigation District's diversions from the Sacramento River. This project involved many state and federal agencies, including California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers, California Department of Water Resources, and the State Reclamation Board.

INTERIM REOPERATION OF FOLSOM DAM AND RESERVOIR EIR/EA

Evaluated the potential impacts of interim reoperation on the warmwater and coldwater fish resources of Folsom, Trinity, and Shasta reservoirs, and the fish resources of the Lower American and Sacramento rivers and the Sacramento-San Joaquin Delta, with an emphasis on anadromous salmonids. Assessments were based on output from USBR's PROSIM (hydrologic), river temperature,

Michael D. Bryan

and salmon mortality models. Also performed an evaluation to determine the optimal shutter configuration at Folsom Dam to maximize beneficial use of Folsom Reservoir's coldwater pool for downstream temperature control. Assessed effects of seasonal temperature regimes that would occur under various shutter configurations on Lower American River steelhead and fall-run chinook salmon.

PROFESSIONAL AFFILIATIONS / CERTIFICATIONS	American Fisheries Society Society of Environmental Toxicology and Chemistry, Northern California Chapter Member
---	--